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ECOLOGY AND EPIDEMIOLOGY RESEARCH STUDIES IN ALASKA. A RESUME O--ETC(U)

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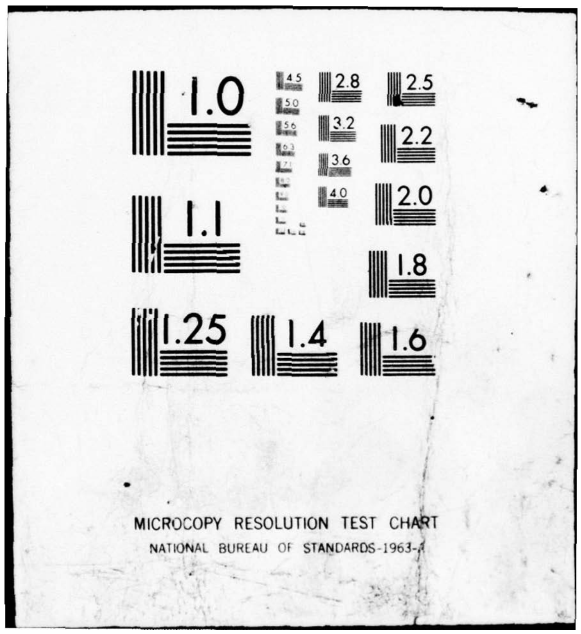
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(6) ECOLOGY AND EPIDEMIOLOGY RESEARCH STUDIES IN ALASKA.

A Resume of Field Collections and Laboratory Diagnostic Assay from 1964-1968.

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THE UNIVERSITY OF OKLAHOMA RESEARCH INSTITUTE

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INTRODUCTION

Unlike previous reports, this is a review of research activities since 1964. Were one to compare data in this report with that of earlier (1965,1966,1967,1968) ones, they would note certain discrepancies. For the most part these have been brought about by reevaluating the data as a whole and arranging it by the calendar year rather than from May to May. It must be kept in mind at all times that this is a resumé, not a final report. The final report will be submitted after the termination of the program.

Figure 1 shows the study areas in which our major efforts were concentrated during the past four years. In addition to these areas, an investigation of one to two week's time each summer was spent at Katalla and Nome. The investigations at Katalla were carried out to give us some comparison with the density of animal faunas in an entirely different biological region from that of the taiga in the interior of Alaska. Nome was selected as an area to compare with similar facets of our problem in the upland tundra, particularly those in the Denali-Paxson area.

ECOLOGY

Detailed descriptions of ecology of the study areas have been given in each of the previous reports. For this reason further discussion does not appear merited at this time.

ARTHROPODS

Approximately 40,000 mosquitoes belonging principally to the genus <u>Aedes</u> have been processed for microbiological assay. This work was done

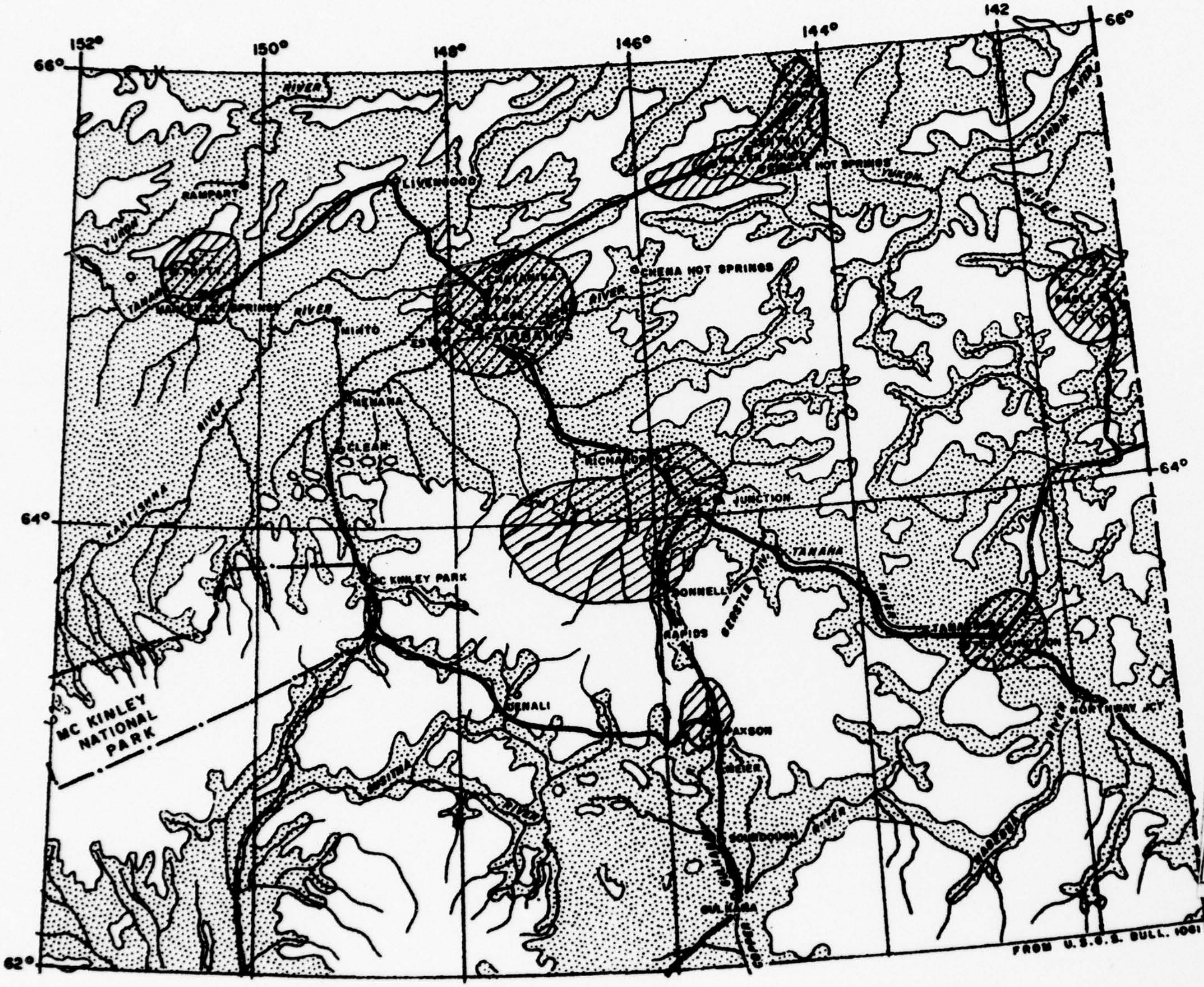

Figure 1. Study Areas in Central Alaska. Locations visited on a regular basis are indicated by ▨. The stippled areas ▒ represent taiga and the clear areas ☐ are upland tundra.

Table 1. Total number of the more common species of fleas encountered during this study.

'Siphonaptera	1964	1965	1966	1967	1968	Total
Catallagia dacenkoi fulleri	112	202	293	315	50	972
Chaetopsylla floridensis	0	5	1	74	97	177
Corrodopsylla curvata curvata	14	23	55	12	11	115
Ctenopsyllus armatus terribilis	0	10	101	179	30	320
Epitedia wenmanni	0	22	51	66	5	144
Hoplopsyllus glacialis lynx	109	651	503	83	34	1380
Malaraeus penicilliger dissimilis	164	284	943	444	201	2036
Megabothris calcarifer gregsoni	67	243	682	208	95	1295
Megabothris quirini	106	434	667	225	86	1518
Monopsyllus vison	220	14	57	177	36	504
Orchopeas caedens durus	156	19	45	230	181	632
Oropsylla idahoensis	75	286	89	67	18	535
Peromyscopsylla ostsibirica longiloba	208	421	289	184	53	1155
Total	1231	2614	3776	2264	897	10782

primarily during the first 3 years and because of completely negative results, was discontinued. However, during the summer of 1969 they will be investigated again.

Acarina has not constituted a major consideration throughout the course of this study. There are times in Alaska when they could be, but unfortunately throughout the course of this study the varying hare has been at the low ebb of its cycle. At this time the tick, *Haemaphysalis leporis-palustris*, disappears along with the hare. As mentioned before, the distribution of this particular tick is not continuous with that of its principal host. We have taken small numbers of immature stages from passerine birds and occasionally have removed them from the gallinaceous birds such as ptarmigan and grouse. Mites have not been especially abundant. Those that have been processed for microbiological assay have given no positive results.

It is perhaps well to mention that one student completed a Masters thesis on the mesostigmatic mites of Alaska from data gathered during the course of this study.

One of the most interesting groups of insects that we have worked with has been that of the Siphonaptera. A total of 11,736 specimens have been taken. Table 1 and Figure 2 summarize the data for the more common species.

Biologically the Siphonaptera have been a highly fascinating group. For example, *Epitedia wenmanni* (Ep.w.) and *Megabothris quirini* (Mg.q.) are both Pleistocene migrants. In Alaska *quirini* occurs principally upon the voles as does *E. wenmanni*. However, *quirini* has been far more

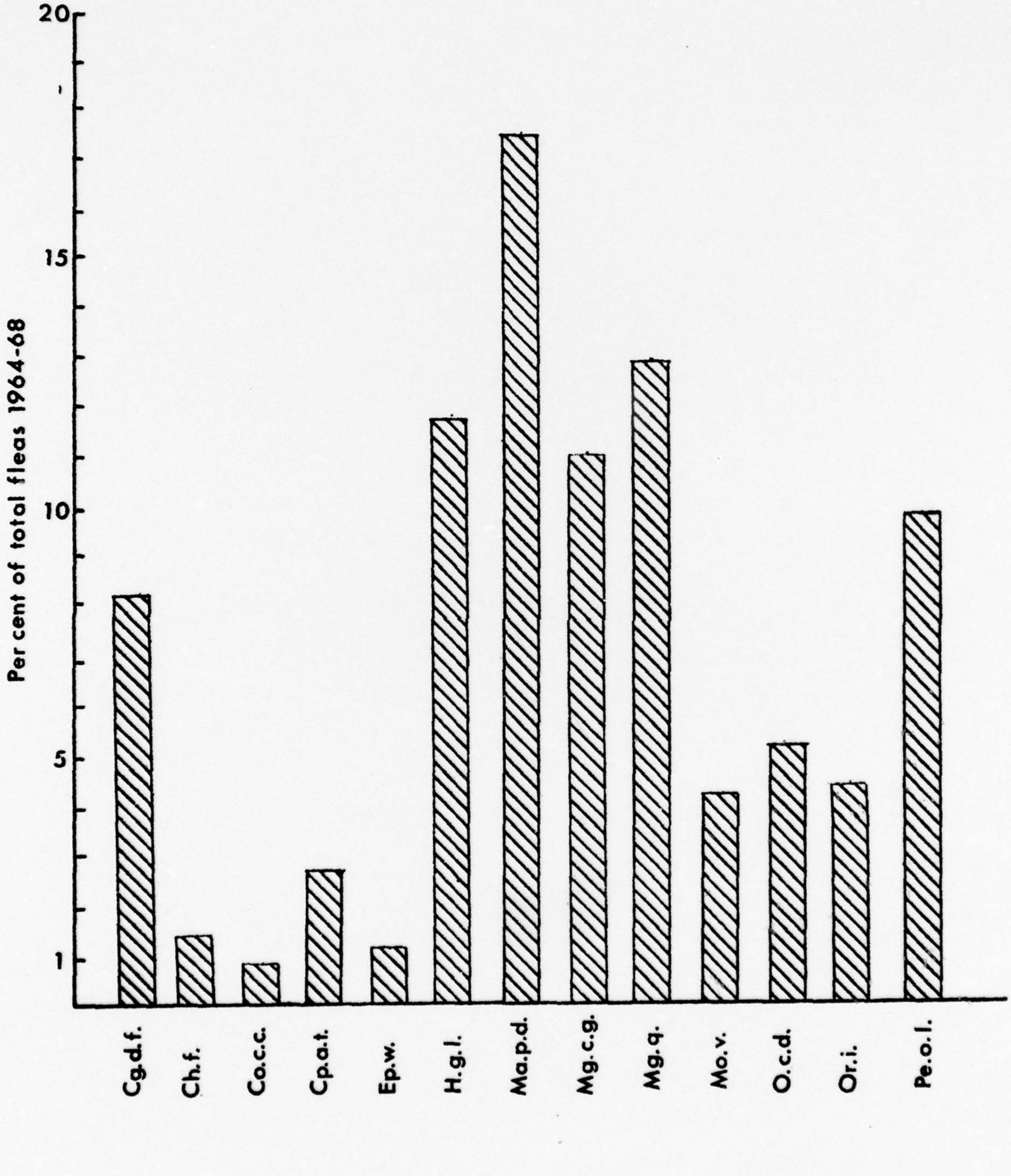

Figure 2. Graphic representation of the more common species of Siphonaptera. These data are based on the total number of fleas taken during the five year period.

successful in the northern portion of its distribution than has wenmanni. The difference may be more apparent than real. E. wenmanni normally parasitizes members of the genera Peromyscus and Neotoma, neither of which have been found in the areas that I have studied. On the other hand, quirini is associated with voles throughout its distribution in the temperate region, and is simply shifted to other species as it has moved northward. Likely this flea moved northward with Microtus pennsylvanicus. It would seem that quirini has had less problems to resolve in its northern migration than wenmanni. E. wenmanni is one of the few species within the order Siphonaptera that exceeds the distribution of its true or primary host.

Information concerning Hoplopsyllus glacialis lynx (H.g.l.) is worthy of comment. As represented in Figure 2 and Table 1 it appears to be one of the more abundant of Siphonaptera. Unfortunately, this is not the case except in total numbers collected. This is an unusual flea in that it appears to survive equally well upon the Lagomorph (varying hare) and the prey (lynx). As to which one the breeding population (or both) are established is not known for certain. It would appear almost ludicrous for this flea to be represented by such large numbers when one is reminded that the varying hare has been virtually absent throughout the course of the study. The high numbers come from the tremendous quantity removed from a small number of lynx. Altogether this flea was not encountered on more than 36 occasions.

Table 2. Percentage variation of the more commonly collected animals from 1964-68. The last column gives the average for the five year period.

% of total mammals	1964	1965	1966	1967	1968	1964-68
C. rutilus	18.42%	22.55%	33.73%	32.44%	31.29%	29.23%
M. oeconomus	27.69	36.45	36.93	34.45	19.87	32.86
L. americanus	10.53	2.46	.503	1.19	2.49	2.18
M. miurus	13.03	4.81	1.76	.239	7.72	3.79
O. collaris	2.26	1.76	1.76	.621	.885	1.41
S. cinereus	1.63	12.19	.660	2.15	4.10	3.86
S. undulatus	4.39	6.36	4.09	3.77	3.46	4.38
T. hudsonicus	16.16	2.03	.503	3.01	3.54	3.13

Table 3. Percent of animals taken in the tundra biome. The percentages cited here are based on the total mammals collected at the locations cited.

	C. rutilus	L. trimucronatus	L. americanus	M. caligata	M. longicaudus	M. miurus	M. oeconomus	O. collaris	S. cinereus	S. undulatus	R. arcticus	Canis lupus
Paxson	65.1	80.0	100	9.67	24.2	59.2	9.6	67.5	43.2	49.7	-	-
Steese Hwy.	25.2	20.0	-	-	75.7	15.1	6.9	.9	51.4	.9	-	-
Nome	3.0	-	-	-	-	17.6	55.0	-	5.4	10.6	-	-
Thompson's Pass	.7	-	-	38.7	-	-	-	5.3	-	20.6	-	-
Dry Creek	6.0	-	-	51.6	-	7.9	3.2	26.3	-	18.1	100	-
Kotzebue	-	-	-	-	-	-	25.3	-	-	-	-	100

With regards to vectoring capacities, the fleas do not appear highly important. Isolation of tularemia organisms were obtained from a pool of fleas removed from Microtus oeconomus at Manley Hot Springs. The fleas in this pool consisted of Malaraeus penicilliger dissimilis, (Ma.p.d.), Magabothris calcarifer gregsoni (Mg.c.g.), and Peromyscopsylla ostsibirica longiloba (Pe.o.l.).

MAMMALS

A total of 9,271 mammals have been examined. Of this total, 1,243 were collected during 1968. The figure for 1968 is the lowest encountered during this study. It does not necessarily reflect a marked decrease in the animal populations, for we were working with only one field crew during the summer where as in previous years two crews had been employed. Nonetheless the populations during 1968 were lower in the taiga regions than for any previous year. On the contrary, the upland tundra in the Denali-Paxson area were high, as well as in the arctic tundra at Nome.

Table 3 presents data, by percent, of the common mammals collected in the tundra at the locations cited. This table actually represents a composite of the 5 years involved. Principally, it reveals that certain species of animals are confined to the tundra whereas others are found in both the tundra and the taiga.

Table 4 presents a summation of the common mammals collected in the taiga and, therefore, for comparative purposes should be compared with Table 3. I have included Paxson in the taiga, not because it actually belongs there, but simply to indicate the difference between

Table 4. Percent of animals taken in the taiga region. The percentages are based on the total mammals collected at the locations cited.

	C. rutilus	L. americanus	M. miurus	M. oeconomus	O. collaris	S. cinereus	S. undulatus	T. hudsonicus	R. arcticus-tarandus	Z. hudsonius
Paxson	9.7	1.4	100	2.4	100	5.7	79.5	0	0	0
Fairbanks	19.8	70.0	0	14.9	0	43.8	0	24.2	0	0
Delta Creek	33.6	2.9	0	6.9	0	0	0	23.4	100	0
Big Delta	19.5	15.7	0	14.8	0	8.8	15.5	7.8	0	0
Circle Hot Springs	6.5	1.4	0	20.7	0	5.6	5.0	40.6	0	0
Manley Hot Springs	10.9	8.5	0	40.3	0	36.1	0	3.9	0	100

mammal populations in the taiga and the tundra biome. The Denali-Paxson area was selected because it was the only location in the tundra biome that was visited on a regular basis, thus the results compare favorably for those listed in the taiga.

Tables 5 through 9 compare the fluctuation in population for a given species from the standpoint of (a), annual variation and (b), the study area. The areas listed were selected because they were visited on a uniform basis, thereby making the data comparable.

These various tables indicate that the two most widely distributed and frequently encountered mammals are the red-backed vole (*Clethrionomys rutilus*) and the tundra vole (*Microtus oeconomus*). Figures 3 and 4 reveal the annual variation of *rutilus* and *oeconomus* by percent based on the total mammals collected. It is evident that each year they have made up a major portion of the animals collected by us.

Figure 5 and 6 illustrate the fluctuations of these two voles in the study areas. The percentages expressed in these two figures are based on the total number of this particular species taken at the localities specified. It is interesting to note that the red-backed vole constituted a large portion of the mammal population at Delta Creek but the tundra vole was not nearly so important. On the other hand, at Manley Hot Springs the reverse was true. The tundra vole represented a high proportion of the animals taken, and the red-backed vole was not nearly so important. This illustrates differences in the basic ecology of the two areas concerned. Delta Creek is a climax black spruce forest with a dense covering of mosses on the forest floor. Manley Hot Springs

Table 5A. Annual fluctuation of *Sorex cinereus* in the taiga.

S. cinereus	1964	1965	1966	1967	1968
Paxson	-	37.5	-	50.00	12.50
Fairbanks	6.45	67.74	1.61	11.29	12.9
Delta Creek	-	-	-	-	-
Big Delta	-	84.00	16.00	-	-
Circle Hot Springs	-	-	-	93.75	6.25
Manley Hot Springs	3.92	73.53	3.92	5.88	12.75

Table 5B. Fluctuations of *Sorex cinereus* population by localities for a given year.

S. cinereus	1964	1965	1966	1967	1968
Paxson	-	3.22	-	18.61	6.25
Fairbanks	66.67	45.16	20.00	32.56	50.00
Delta Creek	-	-	-	-	-
Big Delta	-	11.29	40%	-	-
Circle Hot Springs	-	-	-	34.88	3.13
Manley Hot Springs	33.33	40.32	40.00	13.95	40.62

Table 6A. Annual fluctuation of Tamiasciurus hudsonicus in the taiga.

T. hudsonicus	1964	1965	1966	1967	1968
Paxson	-	-	-	-	-
Fairbanks	58.07	25.81	6.45	3.23	6.45
Delta Creek	6.67	10.00	23.33	20.00	40.00
Big Delta	-	40.00	30.00	30.00	-
Circle Hot Springs	38.46	5.77	5.77	34.61	15.39
Manley Hot Springs	20.00	40.00	-	40.00	-

Table 6B. Fluctuations of Tamiasciurus hudsonicus population by localities for a given year.

T. hudsonicus	1964	1965	1966	1967	1968
Paxson	-	-	-	-	-
Fairbanks	43.90	40.00	13.33	3.33	9.09
Delta Creek	4.88	15.00	46.67	20.00	54.55
Big Delta	-	20.00	20.00	10.00	-
Circle Hot Springs	48.78	15.00	20.00	60.00	36.36
Manley Hot Springs	2.44	10.00	-	6.67	-

Table 7A. Annual fluctuation of Clethrionomys rutilus in the taiga.

C. rutilus	1964	1965	1966	1967	1968
Paxson	13.40	16.49	22.68	5.16	42.27
Fairbanks	9.85	21.71	22.98	12.88	32.58
Delta Creek	-	11.13	53.56	27.89	7.42
Big Delta	-	15.89	76.67	7.44	-
Circle Hot Springs	16.79	-	40.46	41.22	1.53
Manley Hot Springs	7.73	45.46	17.27	20.00	9.55

Table 7B. Fluctuations of Clethrionomys rutilus population by localities for a given year.

C. rutilus	1964	1965	1966	1967	1968
Paxson	25.00	9.01	4.97	2.66	28.87
Fairbanks	37.50	24.23	10.27	13.56	45.42
Delta Creek	-	21.13	40.74	50.00	17.60
Big Delta	-	17.47	33.75	7.71	-
Circle Hot Springs	21.15	-	5.98	14.36	.70
Manley Hot Springs	16.35	28.17	4.29	11.70	7.39

Table 8A. Annual fluctuation of *Microtus oeconomus* in the taiga.

M. oeconomus	1964	1965	1966	1967	1968
Paxson	17.78	31.11	24.44	-	26.67
Fairbanks	25.90	30.58	27.70	11.51	4.31
Delta Creek	-	6.25	63.28	25.78	4.69
Big Delta	-	31.77	51.63	16.60	-
Circle Hot Springs	10.85	-	68.48	13.18	7.49
Manley Hot Springs	9.16	55.38	29.88	2.92	2.66

Table 8B. Fluctuations of *Microtus oeconomus* population by localities for a given year.

M. oeconomus	1964	1965	1966	1967	1968
Paxson	4.19	2.29	1.37	-	15.19
Fairbanks	37.70	13.90	9.60	17.39	15.19
Delta Creek	-	1.31	10.10	17.94	7.60
Big Delta	-	14.38	17.83	25.00	-
Circle Hot Springs	21.99	-	33.04	27.72	36.71
Manley Hot Springs	36.13	68.14	28.06	11.96	25.32

Table 9A. Annual fluctuation of Lepus americanus in the taiga.

L. americanus	1964	1965	1966	1967	1968
Paxson	-	-	100	-	-
Fairbanks	2.04	6.12	-	42.86	48.98
Delta Creek	-	-	-	-	100
Big Delta	-	9.09	90.90	-	-
Circle Hot Springs	100	-	-	-	-
Manley Hot Springs	83.33	-	-	16.67	-

Table 9B. Fluctuation of Lepus americanus population by localities for a given year.

L. americanus	1964	1965	1966	1967	1968
Paxson	-	-	9.09	-	-
Fairbanks	14.29	75%	-	95.46	92.31
Delta Creek	-	-	-	-	7.69
Big Delta	-	25.00	90.91	-	-
Circle Hot Springs	14.29	-	-	-	-
Manley Hot Springs	71.43	-	-	4.55	-

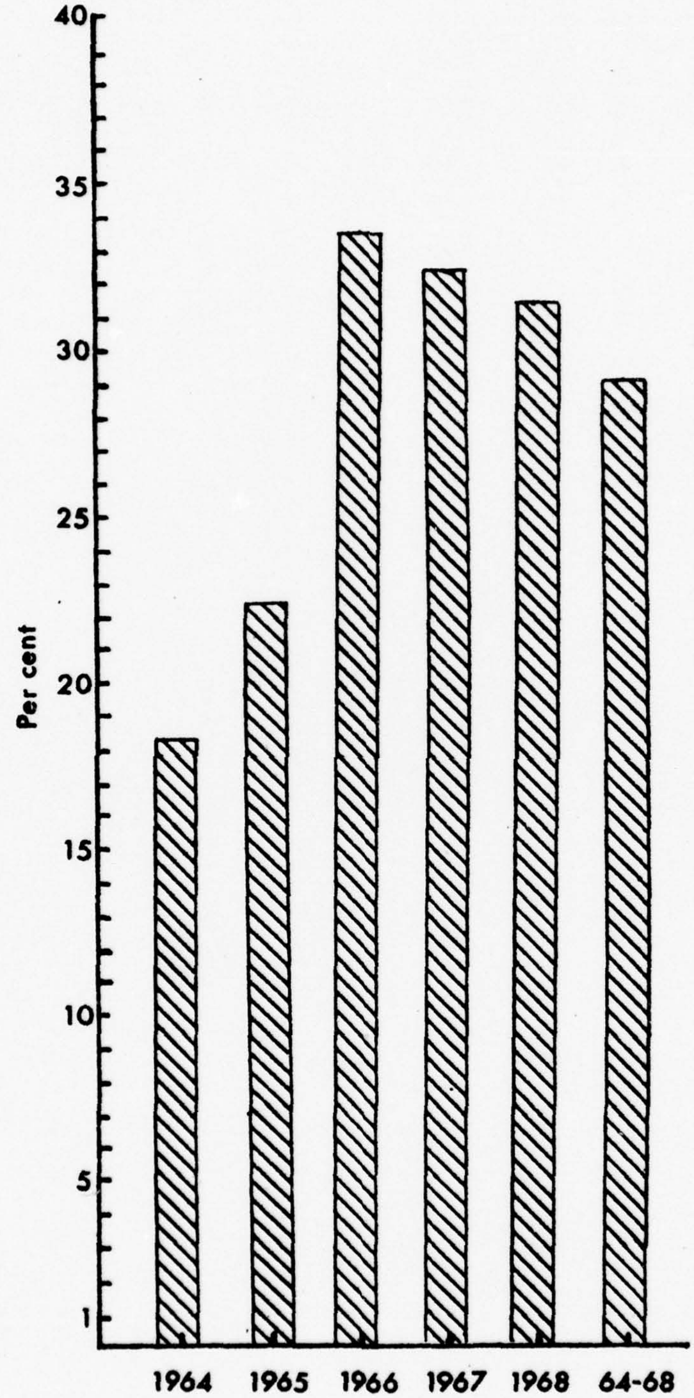

Figure 3. Annual variation of Clethrionomys rutilus by percent based on total mammals collected.

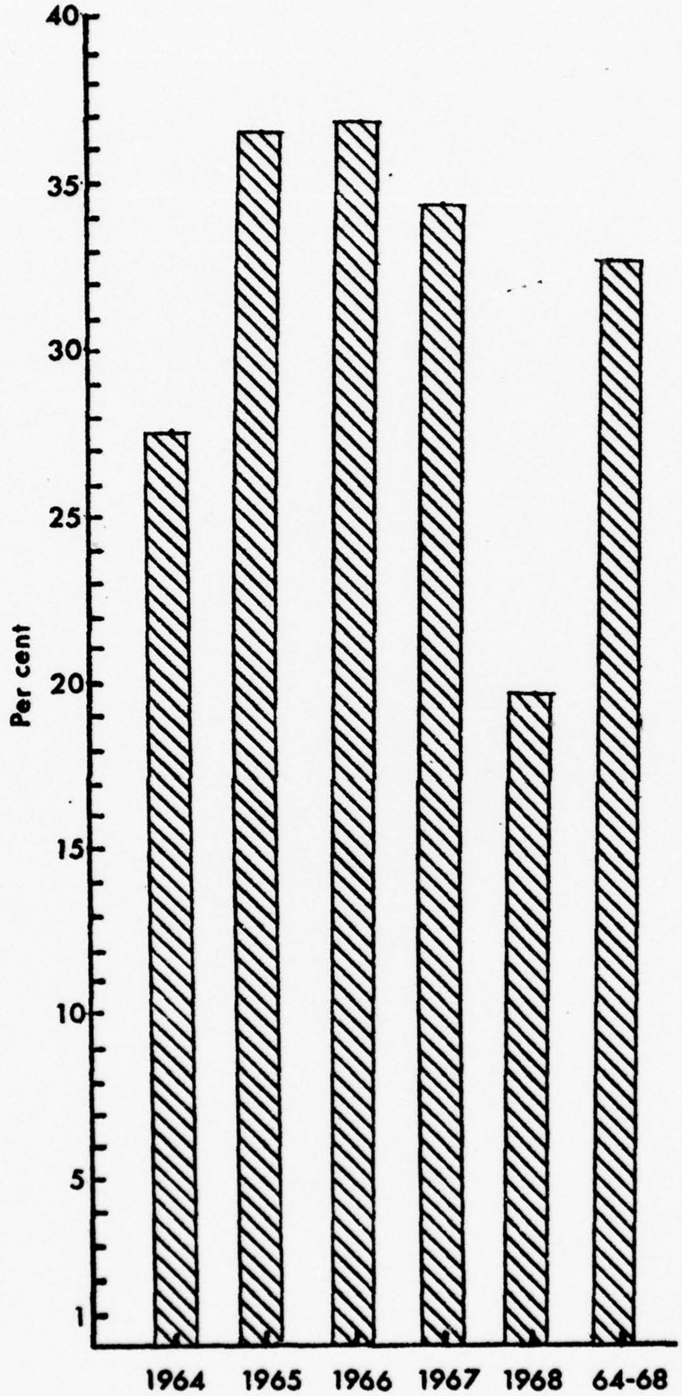

Figure 4. Annual variation of Microtus oeconomus by percent based on the total mammals collected.

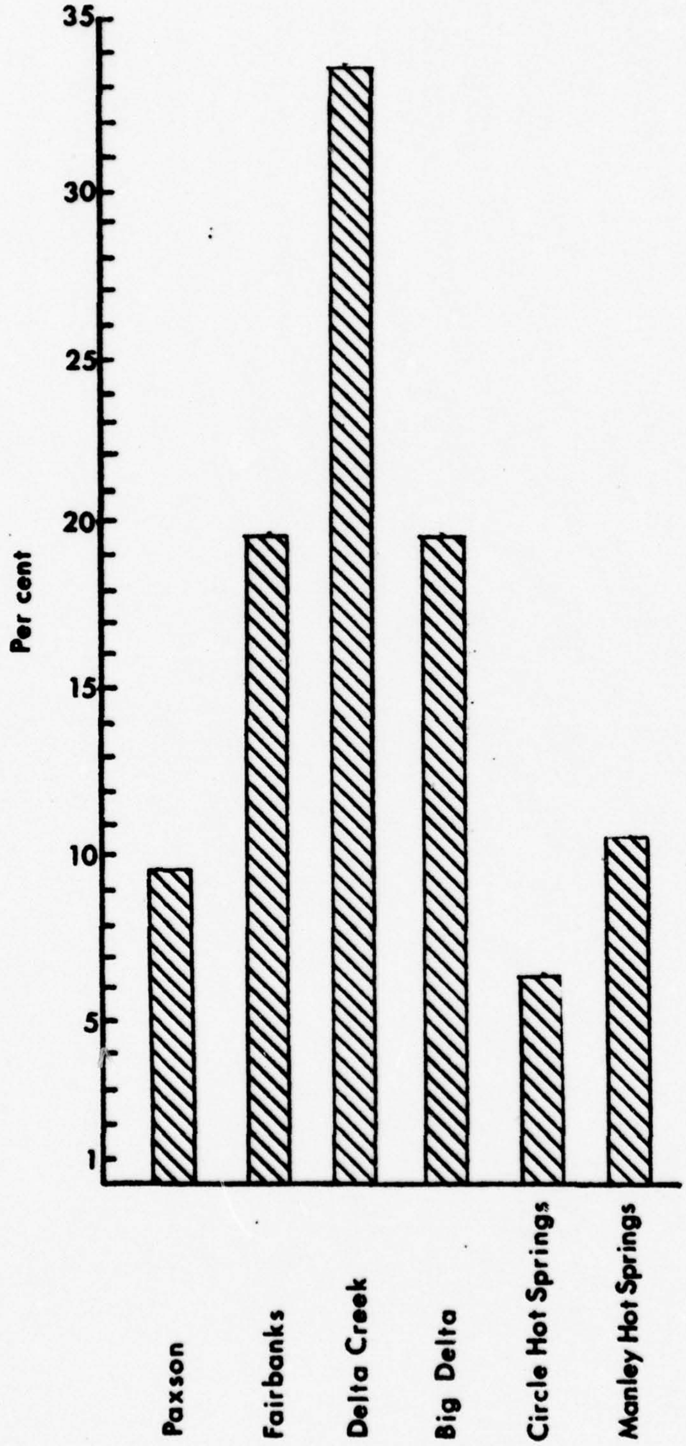

Figure 5. Population fluctuations of Clethrionomys rutilus in study areas based on the total number of this species taken at the localities specified.

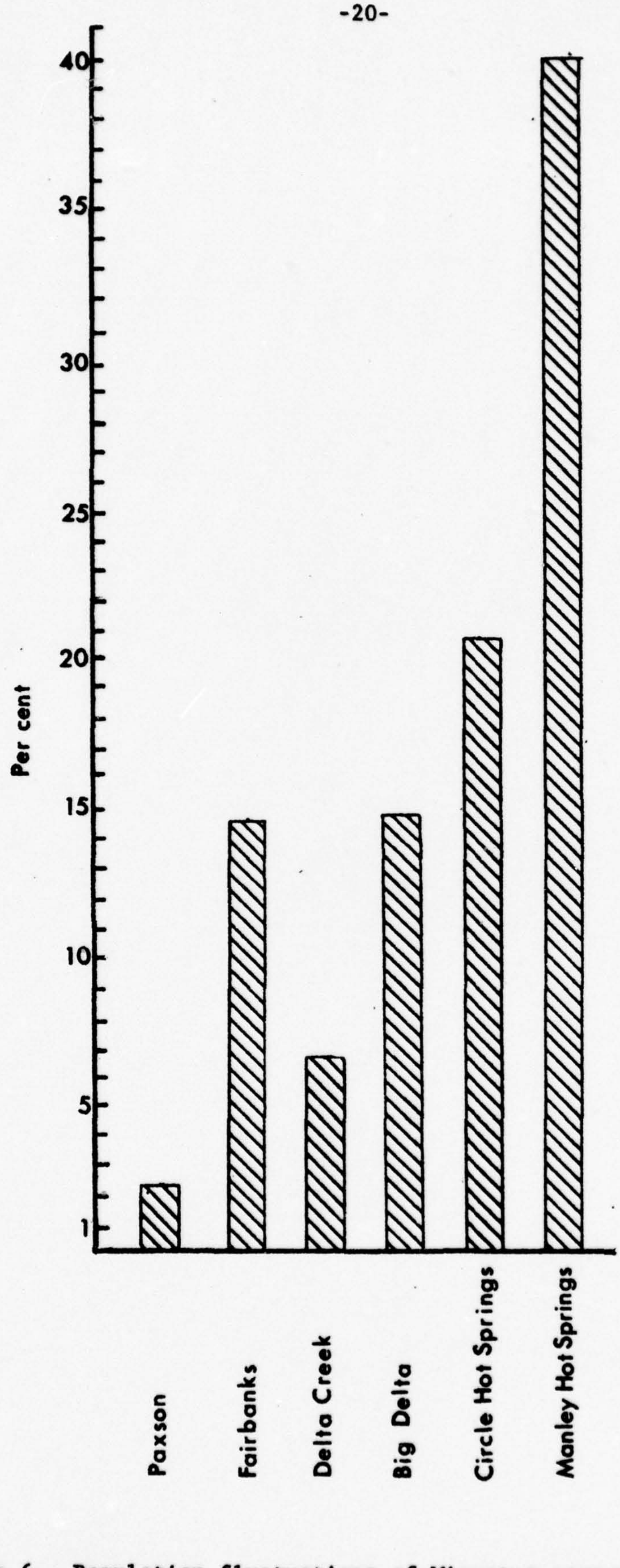

Figure 6. Population fluctuations of Microtus economus in study areas based on the total number of this species taken at the localities specified.

is an area of considerable ecological disturbance with a relatively young secondary growth of aspens and some open plots of grass where cultivation had been attempted earlier.

Figures 3 and 4 indicate that the "high" in the small mammal populations were encountered in 1966, insofar as the taiga was concerned. The "high" for the tundra areas was 1968. It is interesting to observe that the two principal species of voles, which I consider the most valid indicators because of their omnipresence in Alaska, have had low populations throughout the taiga for 1967 and 1968. It is not possible to estimate what the populations of these voles will be like in 1969 because the peak populations occur from August through November. Evidence so far this spring indicates that at Delta Creek, Big Delta, Fairbanks, and Manley Hot Springs are all characterized by small numbers of these animals. This is the time of year when we anticipate that the populations are at their lowest numbers. However, I have not experienced the "lows" that we obtained during April and May this year in previous years. For example, our trapping records at the locations mentioned above reveal an estimate of 6 voles per acre and we have had almost identical results in all four locations. These two voles are the only animals taken in large enough numbers over the years to be able to make a valid comparison of population dynamics.

Table 10 illustrates the number of the more common mammals collected during the course of this study. The last column on the right shows

Table 10. The total number of the more common species of mammals collected from 1964-68.

Species	1964	1965	1966	1967	1968	1964-68
S. cinereus	13	228	21	45	51	358
S. undulatus	35	119	130	79	43	406
T. hudsonicus	129	38	16	63	44	290
C. rutilus	147	422	1073	679	389	2710
M. miurus	104	90	56	5	96	351
M. oeconomus	221	682	1175	721	247	3046
O. collaris	18	33	56	13	11	131
L. americanus	84	46	16	25	31	202

the total number of a particular species taken during this time. From the data presented in this table it is apparent that the most commonly encountered mammal was the tundra vole.

A small scale investigation on the Delta herd of caribou (which are restricted primarily to the north slope of the Alaskan range between the Delta River and Wood River) was started in 1966 and continued through to the present time. Interest in these animals developed fortuitously when it was discovered their range overlapped with an introduced species, the American bison. A fair portion of the latter mentioned species had antibodies for Q-fever, and we were curious to investigate this phenomenon with regards to the caribou. Also, we discovered that virtually nothing was known about the numbers involved in the Delta herd or what their distribution pattern was. Since the area is entered only with the greatest of difficulty, it is not subject to severe hunting pressure.

Originally we were led to believe that not more than 500 caribou existed in the area. We have seen at least one herd ranging somewhere between 4,000 to 5,000 animals. We have now tagged 304 animals in order that some information can be gained as to their movements. The latter operation was carried out in cooperation with the Alaska Department of Fish and Game. Their tags were secured from them, and we placed various colored nylon streamers in the right ear in order that they could easily be spotted for aerial observation. Figure 7 indicates the areas in which the animals have been tagged and where the tagged animals have been sighted subsequently.

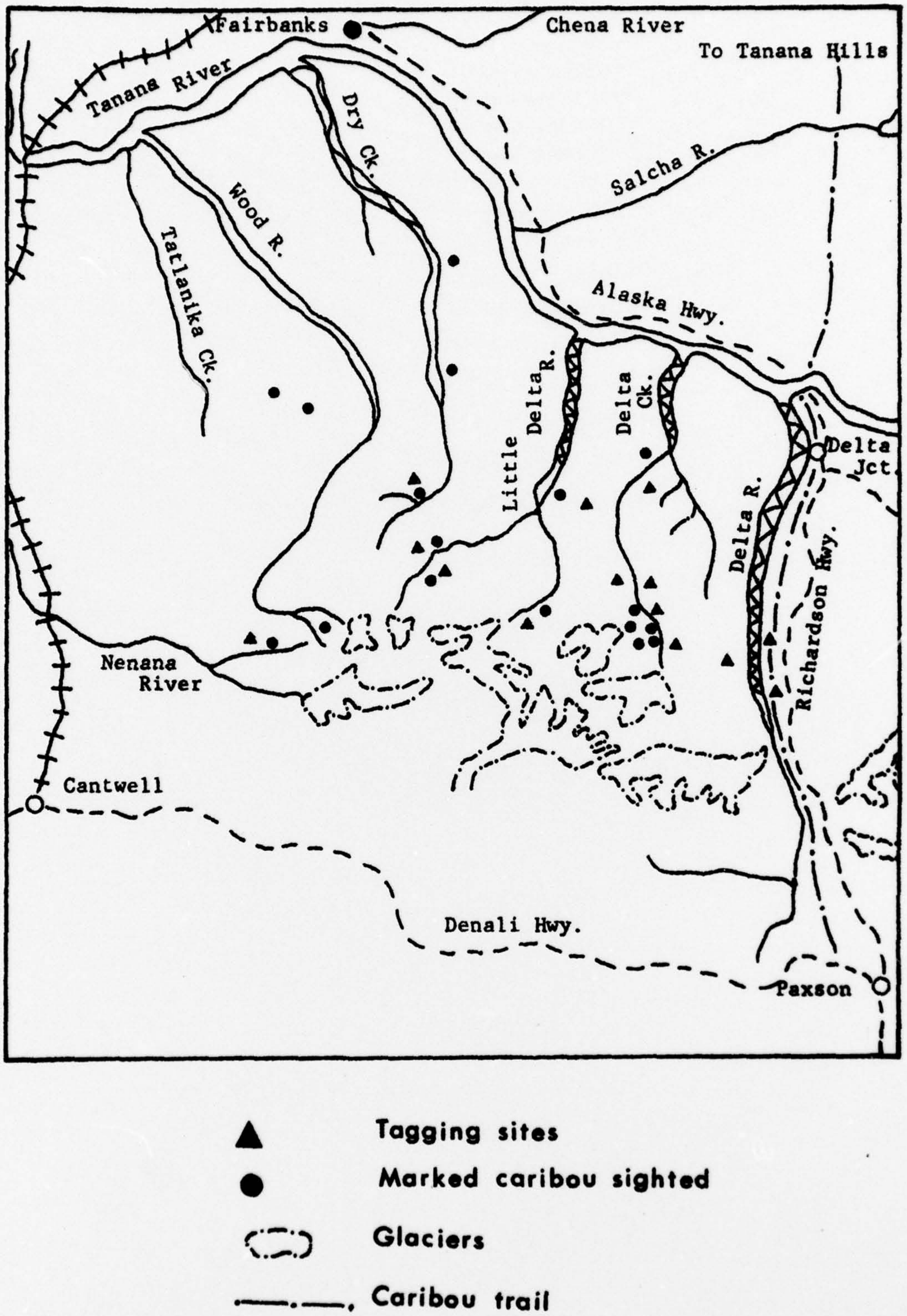

Figure 7. Caribou study. A total of 304 caribou have now been tagged.

It is not meant to imply that we have conclusive results with regard to their migrations or movement patterns. It is interesting that when the study first started the bulk of our animals were located in the Wood River-Dry Creek area, in 1967 they were encountered more commonly near Buchanan Creek, with some numbers always being present in the vicinity of Delta Creek. In 1968 Delta Creek was the principal area involved and in March-April of 1969 the herd was located only 4 miles west of Donnelly Summit. The caribou trail shown running south along the Richardson Highway and north to the Tanana Hills is a theoretical one. There are times when I suspect animals move from the Delta herd into either one of these two directions. It is theorized on the basis of observations up to the present that this kind of migration comes about as the density of the herd reaches around 8 to 10 thousand. Currently, the total population of the Delta herd approximates 7,000 animals.

Figure 9 illustrates the distribution of the caribou, that of the bison, and the zone of overlap between the two. More will be said about this subject later.

BIRDS

A total of 906 birds have been collected representing 70 species, of which 19 are resident and 51 species are migratory. An occasional antibody titre for tularemia was demonstrated in certain species of this avian fauna, but no isolates of tularemia have been obtained.

Table 11. Birds sampled, 1964-1968

Migratory birds

Gavia stellata	Red-throated loon	1
Anas sp.	Duck	1
Anas acuta	Pintail	3
Anas carolinensis	Green-winged teal	6
Anas platyrhynchos	Mallard	2
Mareca americana	American widgeon	1
Spatula clypeata	Shoveler	3
Aythya affinis	Lesser scaup	2
Aythya marila	Greater scaup	2
Bucephala albeola	Bufflehead	3
Grus canadensis	Sandhill crane	1
Pluvialis dominica	American golden plover	8
Actitis macularia	Spotted sandpiper	1
Erolia melanotos	Pectoral sandpiper	2
Limnodromus scolpaceus	Long-billed dowitcher	2
Totanus flavipes	Lesser yellowlegs	4
Tringa solitaria	Solitary sandpiper	4
Lobipes lobatus	Northern phalarope	1
Stercorarius longicaudus	Longtail jaeger	1
Larus argentatus	Herring gull	1
Larus canus	Mewgull	8
Larus philadelphia	Bonaparte's gull	5
Empidonax sp.	Flycatcher	32
Nuttalornis borealis	Olive-sided flycatcher	4
Iridoprocne bicolor	Tree swallow	1
Petrochelidon pyrrhonata	Cliff swallow	44
Riparia riparia	Bank swallow	40
Parus sp.	Chickadee	1
Hylocichla guttata	Hermit thrush	10
Hylocichla minima	Gray-cheeked thrush	4
Hylocichla ustulata	Swainson's thrush	76
Ixoreus naevius	Varied thrush	6
Seirus noveboracensis	Northern thrush	6
Turdus migratorius	Robin	10
Water thrush		1
Anthus sp.	Pipit	12
Anthus spinoletta	Water pipit	2
Bombycilla garrula	Bohemian waxwing	27
Lanius excubitor	Northern shrike	2
Sturnus vulgaris	Starling	1
Euphagus cyanocephalus	Rusty blackbird	1
Dendroica coronata	Myrtle warbler	1
Dendroica petachia	Yellow warbler	3
Oporonis tolmiei	MacGillivray's warbler	1
Vermivora celata	Orange-crowned warbler	8
Vermivora peregrina	Tennessee warbler	1

Migratory birds (cont')

Longspur		1
Calcarius laponicus	Lapland longspur	17
Junco sp.	Junco	15
Junco hyemalis	Slate-colored junco	60
Junco oreganus	Oregon junco	1
Melospiza lincolnii	Lincoln sparrow	35
Passerculus sandwichensis	Savannah sparrow	17
Passerella iliaca	Fox sparrow	16
Plectrophenax nivalis	Snow bunting	2
Spizella arborea	Tree sparrow	19
Spizella passerina	Chipping sparrow	2
Spinus pinus	Pine siskin	1
Tachycineta thalassina	Violet green sparrow	9
Zonotrichia leucophrys	White-crowned sparrow	133
		684

Resident birds

Corvus corax	Raven	8
Perisoreus canadensis	Gray jay	71
Pica pica	Black-billed magpie	3
Bonasa umbellus	Ruffed grouse	2
Canachites canadensis	Spruce grouse	6
Lagopus lagopus	Willow ptarmigan	15
Lagopus mutus	Rock ptarmigan	17
Pediocetes phasianellus	Sharp-tailed grouse	1
Tetraonidae	Grouse and ptarmigan	2
Parus hudsonicus	Boreal chickadee	5
Acanthis flammea	Redpoll	61
Pinicola enucleator	Pine grosbeak	16
Owl		1
Asio flammeus	Short-eared owl	1
Bubo virginianus	Great horned owl	3
Surnia ulula	Hawk owl	2
Colaptes auratus	Yellow-shafted flicker	1
Dendrocopos pubescens	Downy woodpecker	1
		216

Unknown	6
	6
Total birds	906

Table 12. Tularemia isolates 1964-1968

Locality	Year	Host	Strain
Circle Hot Springs	1964	tundra vole	B
Manley Hot Springs	1964	tundra vole	B
Fairbanks	1965	varying hare	A
Big Delta	1965	varying hare	A
Fairbanks	1965	muskrat	B
Delta Creek	1966	red-backed vole	B
Manley Hot Springs	1966	red-backed vole	B
Manley Hot Springs	1966	tundra vole	B
Paxson	1966	tundra vole	B
Katalla	1966	tundra vole	B
Fairbanks	1967	tundra vole	B
Manley Hot Springs	1967	tundra vole	B
Manley Hot Springs	1967	Siphonaptera	B
Nome	1968	tundra vole	B
Nome	1968	tundra vole	B
Nome	1968	red-backed vole	B
Nome	1968	collared lemming	B
Nome	1968	collared lemming	B
Nome	1968	arctic ground squirrel	B
Denali-Paxson	1968	red-backed vole	B
Eagle	1968	marten	B

MICROBIOLOGICAL ASSAY

Figure 8 is a schematic representation of the procedure used for isolation of the zoonoses involved in this study. This procedure has been followed throughout the course of the investigation except for minor variations.

Table 12 is a compilation of the isolates of tularemia made since 1964. It is interesting to observe that nearly half of the isolations were made in 1968, with the largest number of isolates coming from Nome.

It is apparent that we were at Nome during an epizootic, and I strongly suspect at the beginning of it rather than at the peak, or the end. My reason for stating this is born out by the observations that no dead animals were observed anywhere in the study area and no one had noted a die off in the animals. This is a difficult decision to verify. Part of the perplexity stems from the fact that the field crew observed no distinct difference in the voles from which the isolates were made. Part of this series of isolates has been sent to Dr. Cora Rust Owens of the Rocky Mountain Laboratory for confirmation. Dr. Owens has indicated that her observations corroborate ours and that they are strains of moderate virulence.

To indicate something of the virulence of these strains, an occasional guinea pig will survive to the end of the three week period and when sacrificed, will have an enlarged spleen demonstrating characteristic pathology for tularemia, yet these animals almost never have shown a sustained rise in temperature. I have never encountered

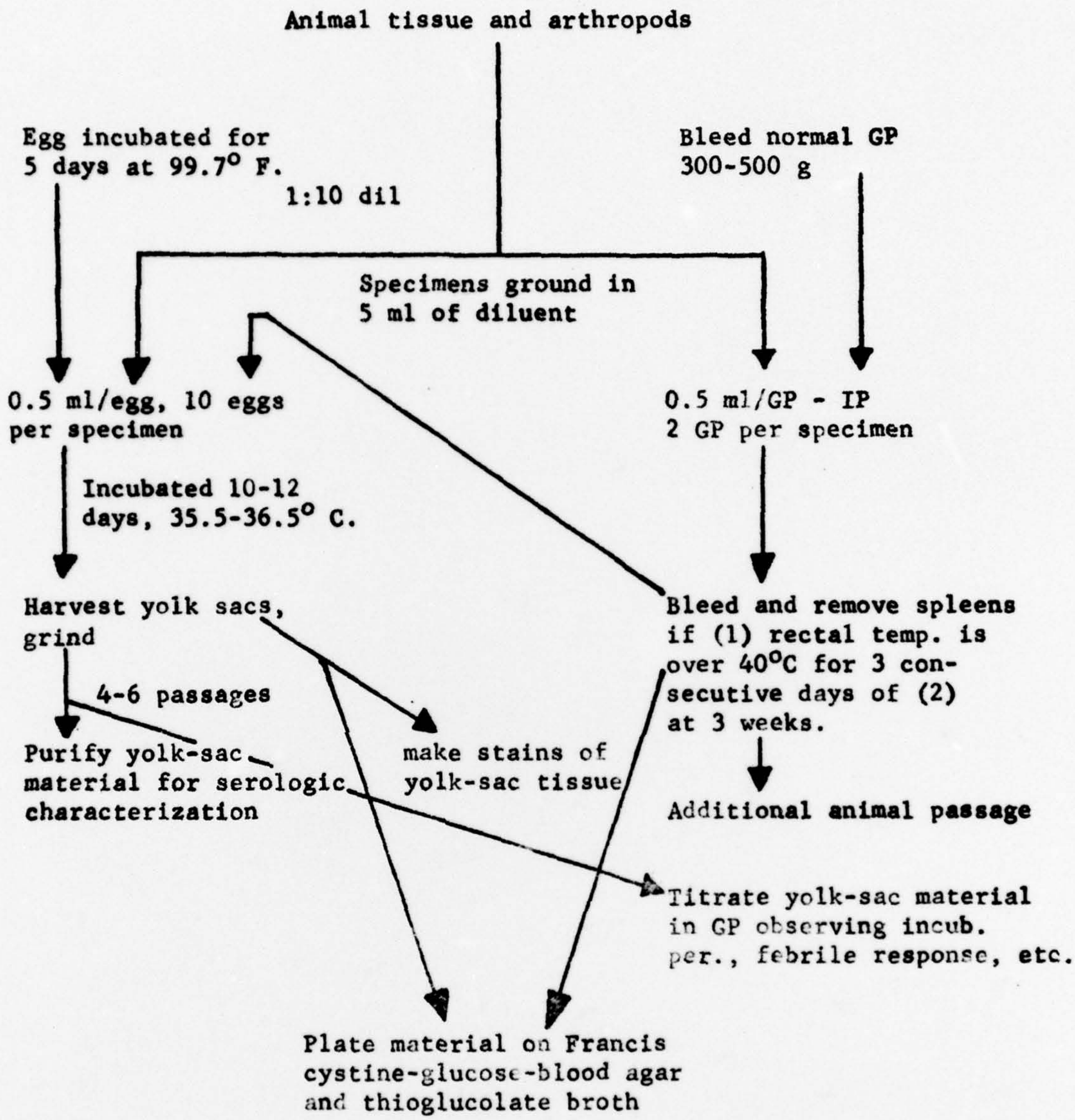

Figure 8. Schematic representation of the procedure used for isolation of _C_. _burneti_ and _F_. _tularensis_.

guinea pig survival in working with <u>tularense</u> organisms in the past.

We have one unconfirmed isolate of tularemia organisms from the Delta Creek area taken in April. This again seems to fit the usual pattern.

I have used the designation of strain A or strain B following the concepts of other North American workers, especially those at the Rocky Mountain Laboratory rather than the concept proposed by Olsuf'yev. The reasons for the former will be mentioned later.

Up to the present time, no isolation of Q fever organisms has yet been made. However, we do have some tissues to process from caribou (those that died from an overdose of the tranqualizing agent) and inasmuch as one of them has demonstrated fairly high titre we hope some of our speculation will be brought to fruition.

Figure 9 shows the distribution of the caribou and that of the bison with the zone of overlap between the two. It will be recalled that we have speculated for the past two or three years that Q fever organisms likely were brought to Alaska when the bison were introduced and have since spread into the Delta herd of caribou. Until isolates can be made from either one or both animals our concepts remain theory. It is also realized that in the event Q fever organisms are isolated once or twice from caribou,studies exploring the infection in caribou and/or bison would have to be made before truly valid concepts could be established.

The information presented in Table 13 illustrates the antibody

Table 13. Antibodies survey of mammalian sera pools 1968-1969. Titres for Q-fever were determined by the CF test; the agglutination test for tularemia and brucella.

Host	Locality	Lab. No.	Q-fever	Tul.	Bruc.
Beaver	Fairbanks	2409	-	-	1:40
Arctic Ground Squirrel	Denali-Paxson	2767	-	1:320	-
"	"	2768	-	1:320	-
"	"	2749	-	1:40	-
"	"	2745	128	-	-
"	"	2553	-	1:20	-
"	"	2754	-	1:20	-
"	"	2755	-	1:40	-
"	Nome	2692	-	-	1:80
"	"	2693	-	1:40	-
"	"	2694	-	1:40	-
"	"	2695	-	1:320	-
"	"	2699	-	1:320	-
"	"	2700	-	1:160	-
"	"	2701	-	1:160	-
"	"	2702	-	-	1:80
"	"	2704	-	1:40	1:40
"	"	2905	-	-	1:40
"	"	2909	-	1:40	-
Red Squirrel	Delta Creek	2752	-	1:640	-
"	"	2765	-	1:20	-
"	"	2758	1:80	-	-
"	"	2759	-	1:160	-
"	"	2762	1:80	-	-
"	"	2763	1:80	-	-
"	"	2764	1:640	-	-
"	Eagle	2769	-	1:40	-
"	"	2757	1:80	-	-
Marten	"	2775	-	1:40	-
Porcupine	Tok	2716	-	1:80	-
Varying Hare	Fairbanks	2867	-	1:160	-
"	"	2780	-	1:640	-
Dall Sheep	"	2818	1:320	-	-
Caribou	Donnelly	2827	-	-	1:20
"	"	2883	-	1:20	-
"	"	2865	-	1:64	-
"	"	2877	1:64	-	-
"	"	2886	1:64	-	-
"	"	2888	1:64	-	-
"	"	2894	1:64	-	-
"	"	2897	1:32	-	-
"	"	2908	1:80	-	-

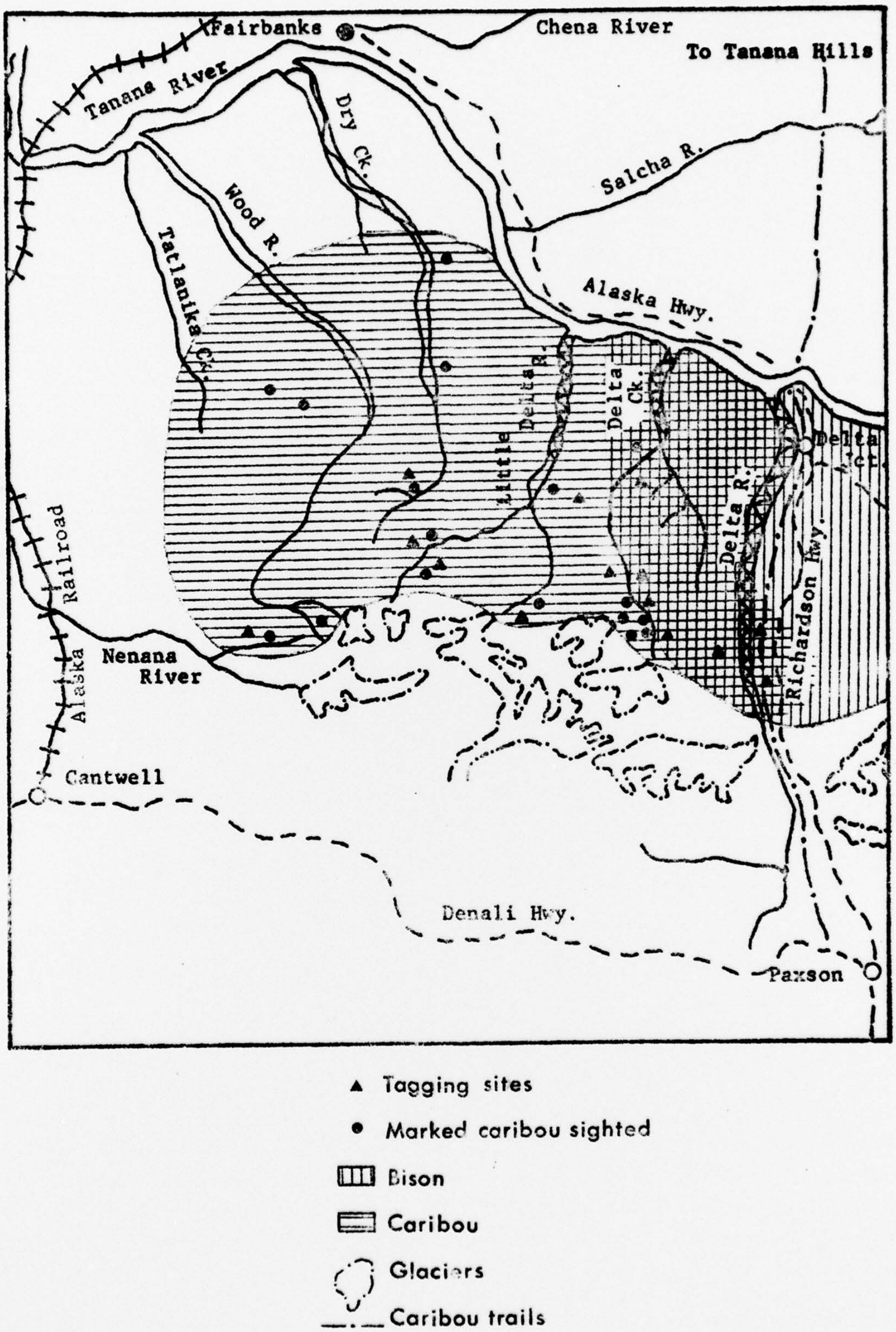

Figure 9. Range of Delta Herd of caribou and that of the bison. The zone of overlap between these two species is thought to have considerable bearing on the question of Q fever.

titres thought to be significant during 1968 and 1969.

During the course of this investigation (1964-current), 152 positive serologies for tularemia involving 21 species of endemic animals have been observed. Q fever has been essentially the same with 160 significant antibody titres from 21 species of mammals.

Figure 10 illustrates the locations in Alaska where isolates of tularemia organisms have been observed. This figure also presents information concerning antibody surveys, both in feral animals and in man. The data by Robert Philip, et al. (1962) are shown because they were primarily involved in the areas other than mine.

In studying the map presented in Figure 10 it is evident that tularemia organisms exist widely throughout Alaska. A study of the isolates obtained thus far indicates, that for the most part, rodents are predominantly the animals involved, but this could change during years when the varying hare has a dense or high population. Also, the isolates are of a lower virulence, for the most part, than those found in the temperate zone, for example, the southeastern United States.

Figure 11 reveals the Olsuf'yev's concepts on the paleogenesis of tularemia. There is much about the ecology of this organism in Alaska that parallels what has been reported by Olsuf'yev and his colleagues. There is much to commend his concepts, but I believe they are too elaborate and/or refined for the present state of our knowledge. It would indeed be interesting if all of the isolates of tularemia organisms from the

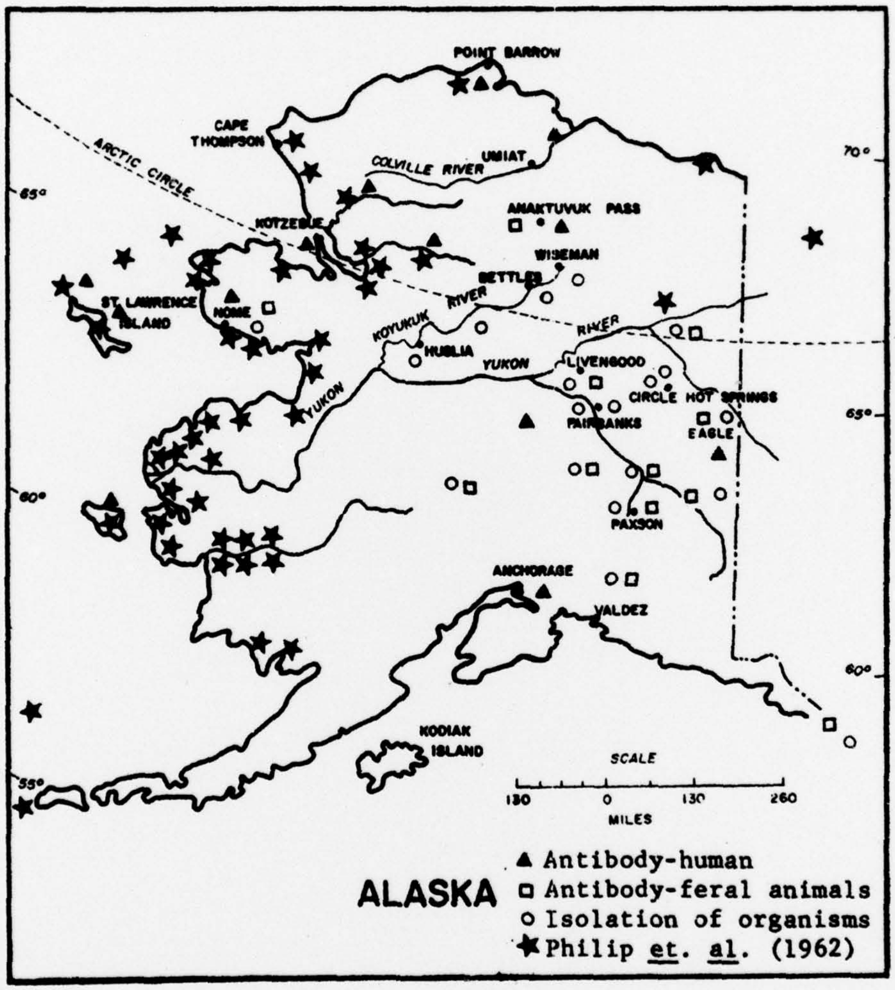

Figure 10. Locations from which *tularemia* antibodies and/or organisms have been recovered.

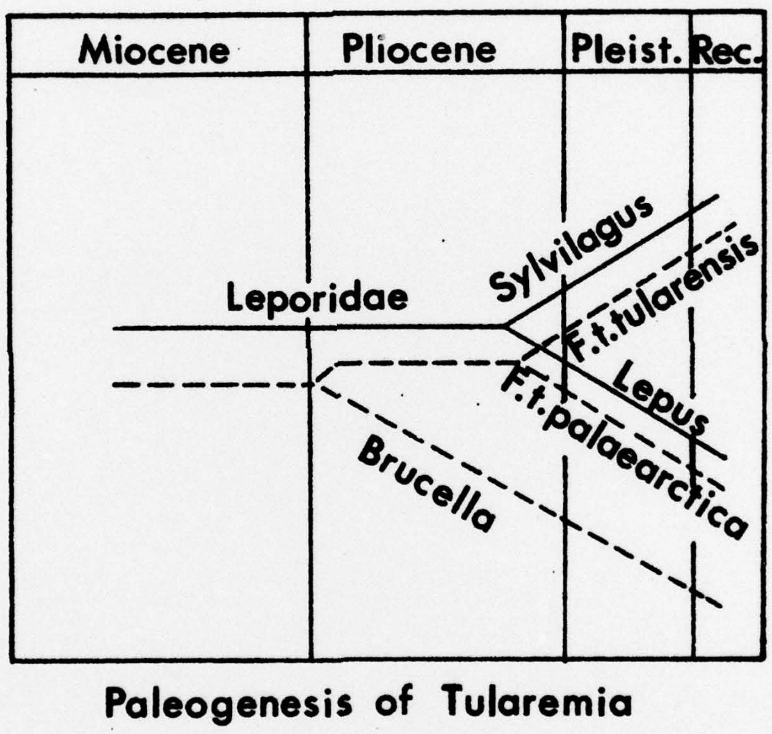

Figure 11. The paleogenesis of tularemia according to Olsuf'yev (1964). Olsuf'yev supported the concept that tularemia has been primarily associated with Leporidae and ticks particularly Dermacentor with a secondary involvement with rodents. Brucella, on the other hand, has been closely associated with the Artiodactyla. Tularemia is thought to have originated in Eurasia and migrated to North America. The nearctic strains are supposedly characterized by higher virulence. Our work in Alaska would appear to refute the last concept.

Nearctic Region and those from the Palearctic Region were to be critically studied for virulence by an impartial group of scientists. I think then we would begin to arrive at a clearer understanding of the paleogenesis of this highly unique biological entity.

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